J. W. BOARDMAN.

APPARATUS FOR RECOVERING MINERAL VALUES.

APPLICATION FILED OCT. 24, 1907.

899,710. Patented Sept. 29, 1908.

3 SHEETS—SHEET 1.

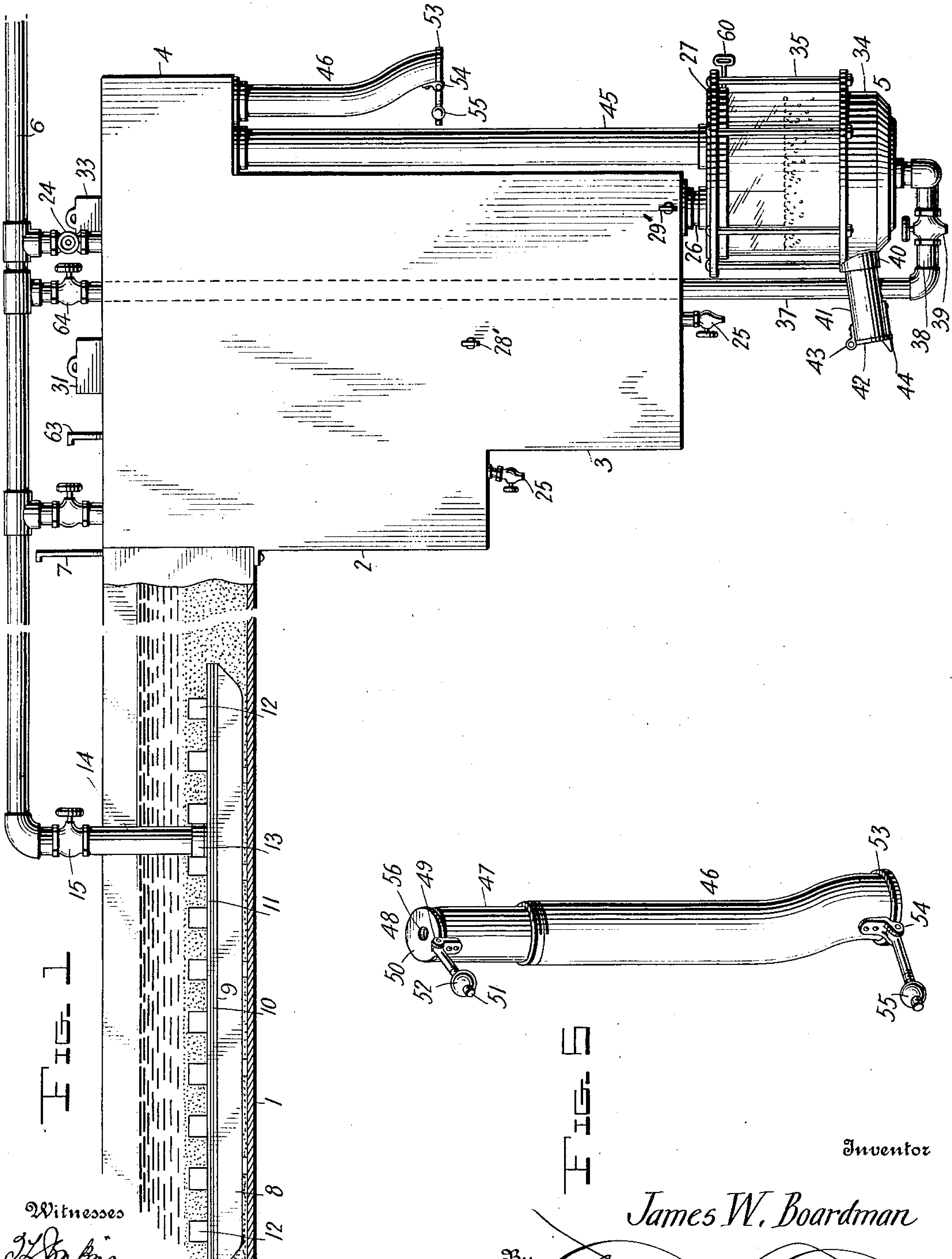

Fig. 1

Fig. 5

Witnesses

[signature]

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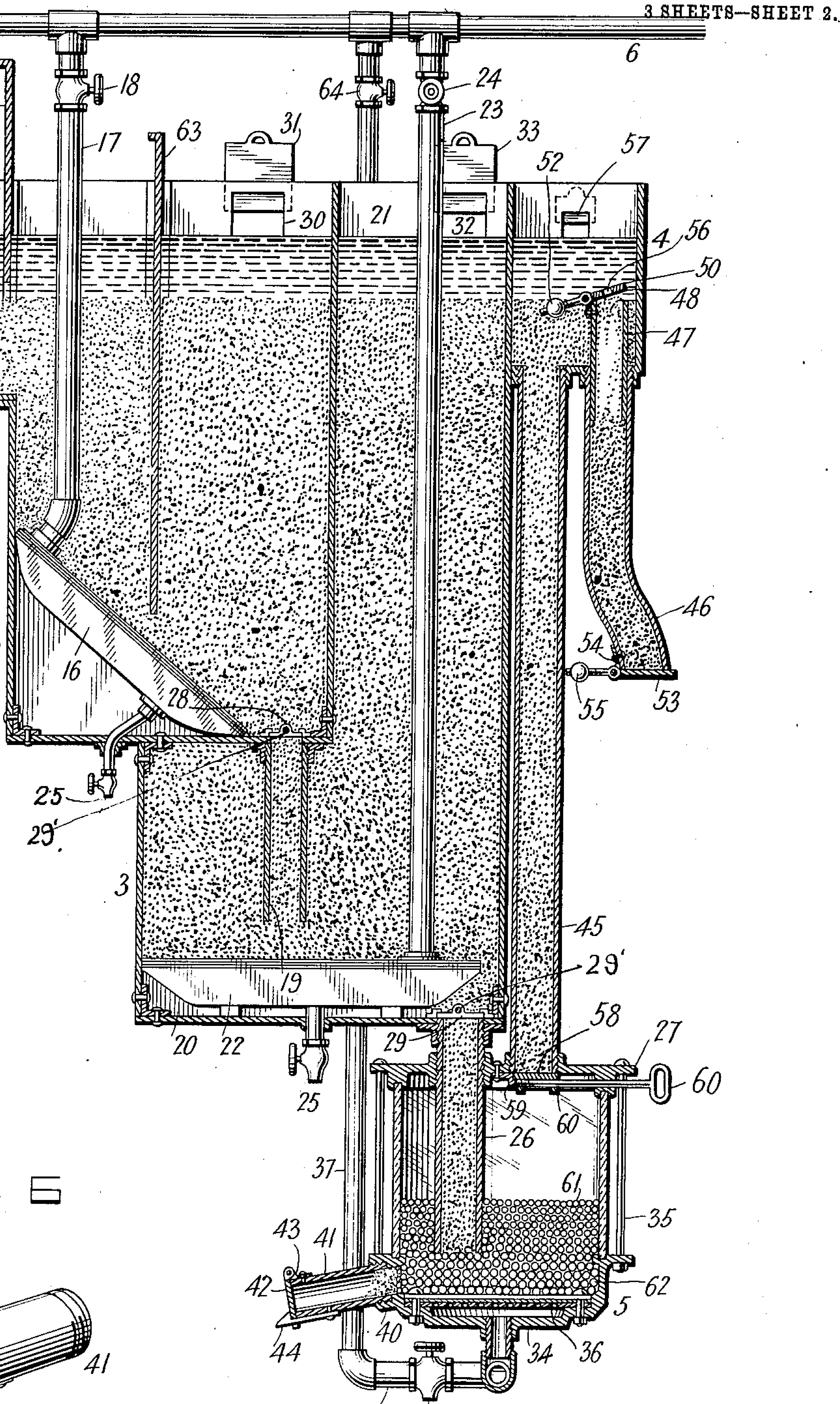
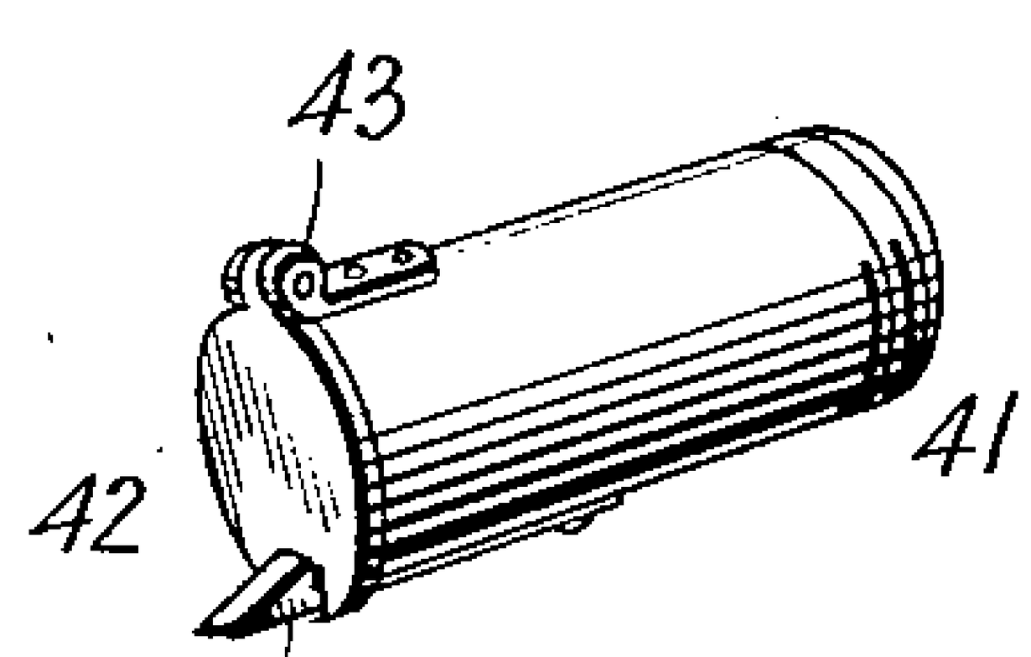


Fig. 2

Fig 6



Witnesses

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3 SHEETS—SHEET 3.

FIG. 7

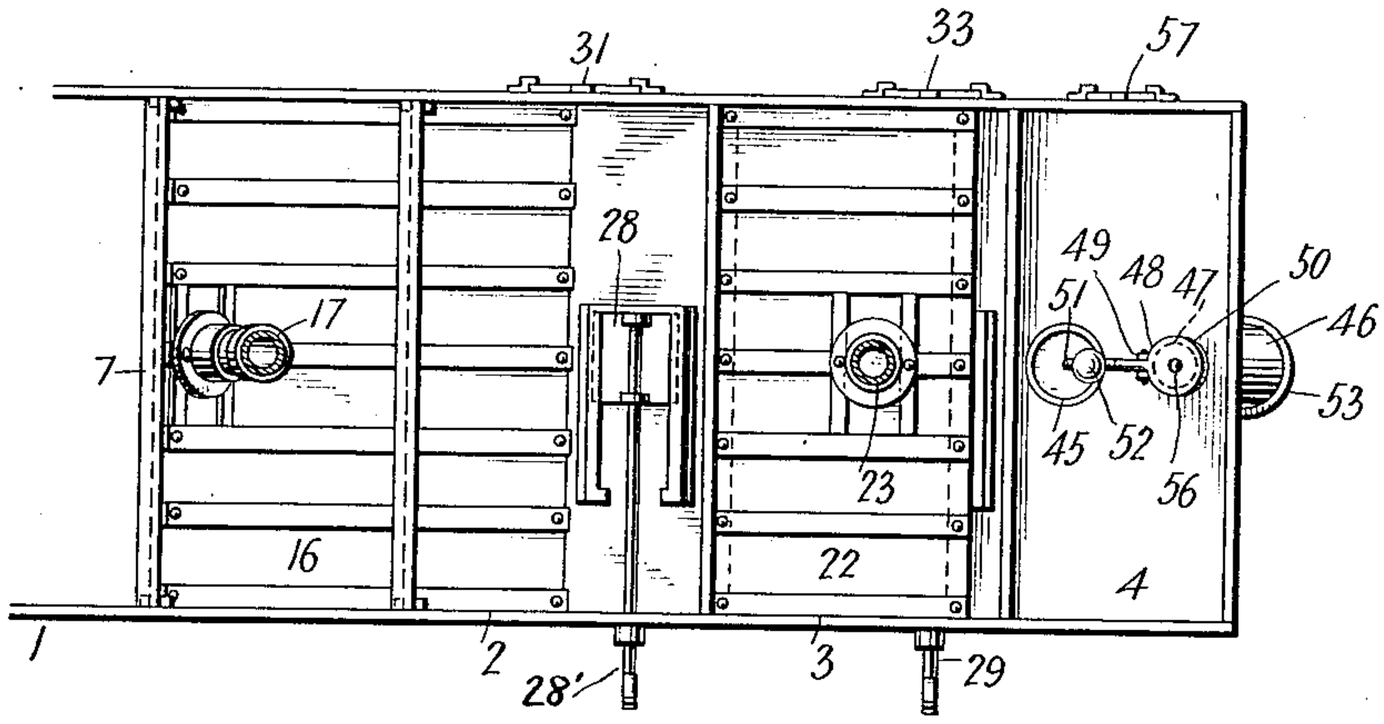


FIG. 3

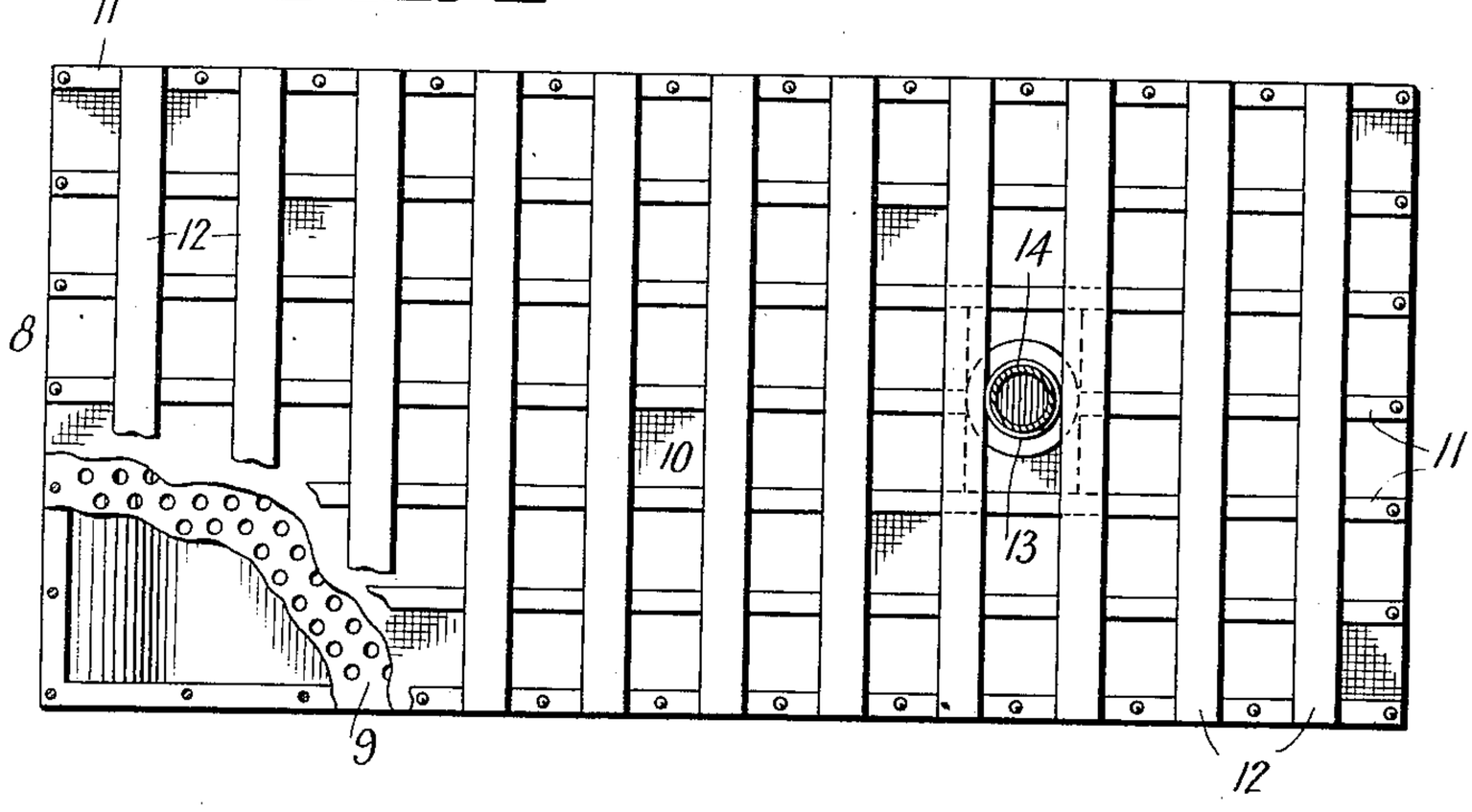
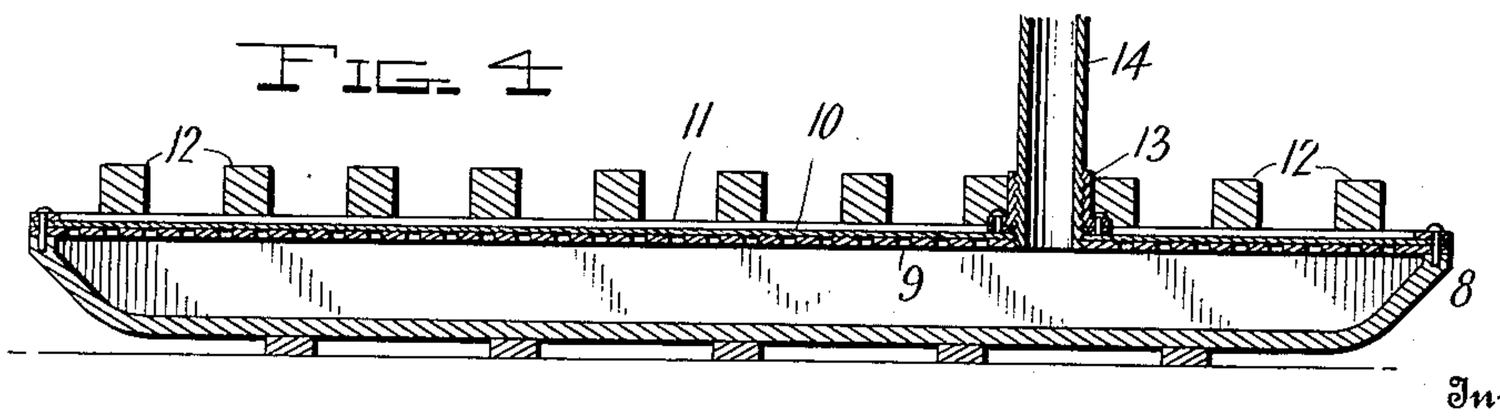


FIG. 4



Witnesses

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UNITED STATES PATENT OFFICE.

JAMES W. BOARDMAN, OF JOSEPHINE, MONTANA, ASSIGNOR OF ONE-FOURTH TO LUCY E. PHILLIPS AND ONE-FOURTH TO MELISSA FRENCH, BOTH OF HARLEM, MONTANA.

APPARATUS FOR RECOVERING MINERAL VALUES.

No. 899,710. Specification of Letters Patent. Patented Sept. 29, 1908.

Application filed October 24, 1907. Serial No. 399,041.

To all whom it may concern:

Be it known that I, JAMES W. BOARDMAN, a citizen of the United States, residing at Josephine, in the county of Gallatin, State of Montana, have invented certain new and useful Improvements in Apparatus for Recovering Mineral Values; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

The present invention has reference to apparatus for recovering mineral values. In apparatus of this class, in which the tailings from the stamp mill are passed through the flume into the agitating tanks, the chief difficulty against which the operators have to contend resides in the extreme liability of the pulverized iron ore, black sand, or magnetite, as it is variously termed, to accumulate in and fill the spaces between the riffles in the flume, becoming so densely packed therein as to completely prevent any settlement of the fine gold which, either alone or in combination with the washings of mercury from the amalgam plate, flows directly over the tops of the riffles into the tanks, rendering the riffles useless and necessitating their constant cleaning.

It is the main object of this invention, aside from the recovery of the greatest possible percent. of values from the tailings, to provide an apparatus in which the above mentioned defect is overcome by utilizing a current of water which is directed into the interior of the spray-box disposed within the flume and is caused to flow upwardly and outwardly through perforations formed in the top of the spray-box, so as to completely prevent any settlement of the magnetite, which is thus carried by the main body of water in the flume through the head gate and into the separating tanks where it is eventually separated both from the waste and from the values, and finally discharged through a chute into ore sacks disposed therebeneath, such discharge being effected automatically at stated periods.

It is a further object of the invention to provide an apparatus of the type set forth in which the action is continuous, requiring no stopping in order to clean up the gold and other values from the bowl into which they finally settle after their passage through the separating tanks.

The invention will be readily understood from a consideration of the following detailed description, and its preferred embodiment is illustrated in the accompanying drawings in which like parts are designated by corresponding reference numerals in the several views.

Of the said drawings:—Figure 1 is a side elevation of the complete apparatus, a portion of the flume being broken away to disclose the spray-box located therein. Fig. 2 is an enlarged vertical section through the separating tanks and bowl. Fig. 3 is an enlarged plan view partly broken away of the flume spray-box, showing the riffles carried thereby. Fig. 4 is a vertical section, showing the construction of the top of the spray-box and the pipe which extends thereinto. Fig. 5 is an enlarged perspective view, of the discharge chute and the regulating sleeve and its trap valve. Fig. 6 is a similar view of the blow off pipe carried by the bowl. Fig. 7 is a plan view of the separating tanks.

Referring more particularly to the drawings, 1 designates, generally, the flume, 2 and 3 the separating tanks, 4 the discharge tank, 5 the amalgam bowl, and 6 the main water-supply pipe which is provided with a series of branch pipes connected with the several elements above referred to.

The flume which is directly connected at its forward end to the tank 2, communicates with said tank through an opening formed in the adjacent side wall thereof, which opening is closed by a movable head gate 7 whose side edges fit between vertical ribs formed upon or secured to the sides of the flume adjacent said opening.

Disposed within the flume is the main spray-box 8 which consists, as shown, of a sheet iron box, watertight at all joints and seams and including a perforated metal top 9 upon which a cover 10 of coarse cloth is disposed, the cover being held in place by metal straps 11 arranged longitudinally of the box. Mounted upon the spray-box top are the riffles 12 which are removably secured thereto in any preferred manner and are arranged parallel with each other and transversely of the spray-box. The spray-box top carries an annular collar or bushing 13 threaded inter-

nally for the reception of the lower end of the branch 14 of the main pipe 6, said branch being provided with a globe valve 15. Owing to this construction, it will be apparent that a current of water will be directed into the interior of the spray-box, it being understood that the portion of the spray-box top inclosed by the bushing is cut away, to permit the entrance of the branch pipe into the spray-box, the water escaping through the perforations in the form of vertical jets. These jets, which are located in the spaces between the adjacent riffles, thus serve to prevent the magnetite from settling in and filling such spaces during the time the apparatus is in operation, as hereinafter described, the force of the jets being regulated by means of the globe valve which controls the supply of water to the spray-box.

The separating tank 2, which is disposed adjacent the discharge end of the flume is likewise provided with a spray-box 16 which is similar, in all essential details, to the spray-box 8, having, however, no riffles. This spray-box is arranged at an incline within the tank, its lower end resting upon the bottom of the tank while its upper end contacts with the outer wall thereof, as shown, a current of water being introduced into the interior of the spray-box by means of the branch pipe 17, the connection between the spray-box and said pipe being similar to that between the spray-box 8 and pipe 14 already described, the pipe 17 being provided with a globe valve 18.

Adjacent the lower end of the spray-box 16 an outlet opening is formed in the bottom of the tank, in which opening the threaded upper end of the vertical feed pipe 19 is fitted, said pipe extending into the horizontal section or arm 20 of the tank 3. This last-mentioned tank is approximately L-shaped in cross-section, and is so disposed with reference to the tank 2 that the bottom of the latter forms the partition between it and the horizontal arm of the tank 3, while its inner wall forms the partition between it and the vertical arm 21 of the last-mentioned tank.

The feed pipe 19 extends to within a short distance of a spray-box 22 which rests upon the bottom of the tank 3 and is supplied with water from a branch pipe 23 having a globe valve 24, the spray-box and its pipe connection being identical with those above described. The spray-boxes 8 and 22 are each provided with a valved pipe connection 25, by means of which the mud may be drained therefrom, said pipes projecting through openings formed in the bottom of the corresponding tanks.

The tank 3 is likewise provided with an outlet opening formed in the bottom thereof, adjacent one end of the spray-box 22, to receive the threaded upper end of a feed pipe 26 which extends downwardly through the cover 27 of the amalgam bowl 5 into the interior thereof. The feed pipes 19 and 26 have their upper ends provided with sliding gates 28 and 29 respectively, which move directly there-across and have stems 28′ and 29′ which extend through openings formed in the walls of the corresponding tanks, to permit the gates to be operated manually. Any desired form of guides may be provided to retain the gates in proper position during their sliding movement.

The operation of the apparatus up to this point may be briefly described as follows:— The tailings, after having been subjected to a preliminary screening, are fed into the flume and are carried by the main body of water therein over the spray-box 8 and through the head gate into the tank 2, the gate 28 of which has previously been closed. Owing to the force of the jets of water which issue from the spray-box 8, the black sand or magnetite will be prevented from settling down and filling the spaces between the riffles, which latter remove the fine gold only, owing to its greater specific gravity. The tank 2, in the mean while, has been filled with water from the spray-box 16, and into this tank the tailings are fed through the head gate until they begin to flow out through the waste opening 30 which is formed in one of the walls of the tank above the level of the flume bottom and is provided with a gate 31. At this point, the gate 28 in the bottom of the tank is opened, and the tank 3 filled through the feed pipe 19, the flow of tailings continuing until the level of the waste opening 32 is reached, this opening being likewise provided with a gate 33. Owing to the agitating action of the spray-boxes 16 and 22, through which the water is forced in minute jets, the earthy matters and such other lighter waste present in the tailings, will rise and be discharged through the waste ways, while the gold and the other values, such as platinum, mercury, and tin, (which appear to more or less extent in the tailings), together with the magnetite gradually settle down to the bottom of the tanks.

When the tank 3 has been filled, as above described, its gate 29 is then opened, and the bowl 5 filled in a similar manner. This bowl, as shown, comprises a cylindrical body portion of heavy glass upon the upper and lower edges of which the cover plate 27 and bottom plate 34 respectively, are fitted, said plates being secured together by a series of vertical brass rods 35 which extend at opposite ends through perforations formed therethrough. The bottom plate, which is cup-shaped, carries a spray-box 36 bolted thereto, and similar in construction to those already described, said spray-box being supplied with water by a branch pipe 37 disposed exteriorly of the tanks and connected at its lower end to a supplemental pipe 38 com-

municating, in turn, with the bowl bottom, which latter has a central opening formed therethrough, to admit the threaded upper end of the last-mentioned pipe. This pipe is likewise provided with a mud-cock 39.

The feed pipe 26, which extends from the tank 3 through an opening in the cover plate 27 into the interior of the bowl, terminates at its lower end within a very short distance of the spray-box 36, while the vertical wall of the bottom plate 34 is provided with an internally threaded sleeve 40 in which the inner end of a downwardly inclined blow-out pipe 41 is fitted, said sleeve being formed integral with said plate. At its outer end, the pipe 41 is provided with a gate 42 whose reduced upper end is pivoted between a pair of ears 43 mounted upon the upper face of said pipe while its lower end is normally engaged by a spring latch 44 secured at one end to the under face of the pipe, the gate being thus held against the mouth of the pipe to prevent the contents of the spray-box from escaping therethrough until the proper time.

The bowl cover is provided, in addition, with a second opening in which the lower end of the vertical outlet pipe 45 for the magnetite fits, said pipe being carried by the discharge tank 4 which forms a continuation or extension of the tank 3, the last-mentioned tank, however, having no direct communication with the discharge tank. The discharge tank is further provided with a discharge chute 46 in the form of a pipe, in the upper end of which chute is fitted a movable sleeve 47 by means of which the level of the magnetite within the several tanks is regulated. This sleeve carries at its upper end a trap valve 48 pivoted centrally between a pair of ears 49 secured to or formed upon the sleeve, the trap valve having one end enlarged to form a gate 50 adapted, at times, to cover the sleeve end, and its opposite end reduced, as indicated by the numeral 51, said reduced end being threaded and fitted in an opening formed in a weight 52, the weight holding the gate end of the trap valve normally raised to a degree sufficient to permit the magnetite to gradually accumulate in the chute 46, whose lower end is normally closed by a trap valve 53 pivoted in like manner between a pair of ears 54 secured to the chute, and having its reduced end portion provided with a weight 55. It will therefore be apparent that the magnetite, which is continually being carried up from the bowl 5 through the outlet pipe 45 into the discharge tank, will gradually collect in the chute until the weight of the mass so collected exceeds that of the weight 55, whereupon the trap valve 53 will open, discharging the magnetite, from which all values and waste have been completely separated, into the ore sacks which are disposed at the discharge end of the chute. At the same time that the trap valve 53 opens, the trap valve 48 closes, under the weight of the water thereabove, until the first-mentioned trap valve is again closed whereupon the trap 48 again opens. The gate portion of the trap valve 48 is provided with a single perforation 56 through which a small stream of water flows into the chute, to flush the same during the discharge of the magnetite therefrom. The discharge tank 4 is likewise provided with a water gate 57.

The opening in the bowl cover in which the lower end of the outlet pipe is fitted is closed during the filling of the bowl from the pipe 26, and during the removal of the values from the bowl, by means of a sliding gate 58 held in place against the under face of the cover by means of guide grooves 59, and manipulated by a handle 60 which extends through an opening formed in the depending flange formed upon said plate, in which flange the upper edge of the cylindrical body of the bowl is received.

Prior to the admission of the tailings into the bowl, the gate 58 is opened, and a quantity of bird shot sufficient to half fill the bowl is poured thereinto through the pipe 45, the shot being then covered by a layer of copper filings which are introduced into the bowl in a similar manner. The layer of filings, which has a depth of approximately one inch, is indicated by the numeral 61, and the shot by the numeral 62.

The tank 2, if desired, may be provided with a vertical partition 63, which is slidable therewithin and is operated manually. The pipe 37 through which water is introduced into the spray-box 36, includes a globe valve 64.

From the foregoing description, it will be apparent that the mineral values will gradually settle from the two separating tanks into the amalgam bowl, while the magnetite will gradually pass from one tank to the other, through the bowl and outlet pipe into the discharge tank, whence it will collect gradually in the chute and discharge itself automatically therefrom into the ore sacks. The mass in each tank will be held in suspension by the action of the spray-boxes, so as to allow the lighter particles of waste, such as the earthy matters, to rise and be carried away through the waste ways, while the mineral values will settle to the bottom of the tanks and will eventually accumulate in the bowl. Owing, however, to the presence of mercury in the tailings, due to the washings from the amalgam plate, and to some slight extent, from its existence in the ore fed to the stamps, the lead and copper will combine with the mercury and gold forming an amalgam. This amalgam can be readily removed from the bowl without necessitating the complete stoppage of the washing operation, by merely closing the gates 29 and 58 and by opening the valve 64 to its fullest extent, the

force of the water being sufficient to blow the mass through the pipe 41, whereupon any free gold appearing in the mass may be removed by panning, while the amalgam is separated into its constituents in any ordinary manner, the mercury being removed by distillation, and the lead by roasting in any open furnace. It is obvious, however, that the operation of the apparatus, as a whole, may be regarded as continuous, in as much as the magnetite is automatically separated from the waste and amalgam, and is periodically discharged through the chute into the ore sacks, the apparatus running itself, so to speak.

Where river sand rather than mill tailings, is treated, the process is the same, in the main, as that already described, the free gold collecting in the bowl, whence it can be readily removed when a sufficient quantity has accumulated, it being possible to watch such accumulation by reason of the formation of the body of the bowl of glass. It is to be understood, likewise, that a quantity of gold, either in a free state or in combination with mercury, according as river sand or mill tailings are treated, will be caught by the riffles in the flume filter, from which it can be easily removed in the ordinary manner.

Where tailings are treated, it will be noted that a great percent. of the mercury present both in the ore and from the washings of the amalgam plate in the stamp mill, will be recovered. In each process, moreover, the magnetite, which has a recognized commercial value at the present time, is completely separated from the waste and values, and is automatically discharged periodically from the apparatus.

What is claimed is:—

1. The combination, in an apparatus, for recovering mineral values, of a plurality of superposed separating tanks communicating with one another; means for discharging comminuted particles into the uppermost tank; an exteriorly-located bowl disposed beneath the lowermost tank and communicating with the same; means located within each tank and within the bowl, for effecting an upward agitation of the contents thereof; means for discharging the heavier constituents of the contents of the bowl; a discharge tank located above said bowl; an outlet pipe connecting said discharge pipe with said bowl, to permit the lighter constituents of the contents of the bowl to pass into the last-mentioned tank; a discharge chute communicating with said last-mentioned tank; and means for periodically effecting an automatic discharge of the contents of the chute.

2. The combination, in an apparatus, for recovering mineral values, of a plurality of communicating separating tanks; means for feeding water and comminuted particles into one of said tanks; a spray-box located at the bottom of each tank for agitating the contents thereof; a separate bowl located exteriorly of the tanks; a feed pipe connecting said bowl with another of the tanks; and separate means for effecting the discharge of the heavy and light constituents of the contents of said bowl.

3. The combination, in an apparatus of the class specified, of a separating tank; an inclined spray-box disposed within said tank and provided with a perforated top; a vertical plate movable towards and from the spray-box; and a water-supply pipe communicating with the interior of said spray-box to effect an upward flow of water through said receptacle and an agitation of the contents thereof.

4. In an apparatus for recovering mineral values, in combination, a concentrating receptacle; a spray-box disposed within said receptacle and comprising a metal box having a perforated metal top, a cloth cover disposed upon said top, and an internally threaded collar carried by said top; and a water-supply pipe having one end fitted in said collar, to direct a current of water into the interior of the spray-box.

5. In an apparatus for recovering mineral values, the combination, with a flume, of a spray-box provided with a perforated metal top, a cloth cover mounted upon said top, metal straps for retaining said cover in place, a series of riffles mounted upon said cover, an internally-threaded collar carried by said top, and a water-supply pipe having one end fitted in said collar, to introduce a current of water into the interior of the spray-box and to effect an upward flow thereof between the riffles.

6. In an apparatus of the character specified, in combination, a tank; means for feeding matter thereinto; a vertical discharge chute carried by said tank and adapted to receive matter therefrom; and a movable trap valve located at each end of said chute, for opening and closing the same, the upper trap valve having a perforation formed therethrough.

7. In an apparatus of the character specified, in combination, a tank; means for feeding water and comminuted particles thereinto; a vertical discharge chute carried by said tank; and a pivoted trap valve located at each end of said chute for opening and closing the same, the lower trap valve being adapted to open automatically under the weight of the contents of the chute, to periodically discharge the same, and the upper trap valve being adapted to close when the lower gate is open, said upper trap valve being provided with a perforation to admit water into the chute to flush the same during the discharge of its contents.

8. In an apparatus of the character speci-

fied, the combination of a tank; means for feeding water and comminuted particles thereinto; a vertical discharge chute carried by said tank; a movable sleeve fitted in the upper end of said chute, for regulating the level of the particles within the tank; a pivoted trap valve secured to the lower end of said chute; and a pivoted trap valve secured to the upper end of said sleeve, said valves being adapted to be operated by the contents of the tank.

9. In an apparatus of the character specified, in combination, a plurality of communicating tanks; means for feeding water and comminuted particles into one of said tanks; means disposed within each tank for effecting an agitation of the contents thereof; a bowl communicating with another of said tanks; means for effecting an agitation of the contents of said bowl; a blow-off pipe and an outlet pipe connected with said bowl; a discharge tank communicating with said outlet pipe; a discharge chute carried by said discharge tank; and means for periodically effecting an automatic discharge of the contents of said chute.

10. In an apparatus of the character specified, in combination, a separating tank; means for feeding water and comminuted particles thereinto; a bowl disposed beneath said tank; a pipe connecting said bowl and tank, for feeding the contents of the latter into said bowl; a blow-off pipe carried by said bowl; a spray-box located in the bottom of said bowl and provided with a perforated top; and a water-supply pipe having one end communicating with said spray-box to discharge the heavier particles through said blow-off pipe.

In testimony whereof, I affix my signature, in presence of two witnesses.

JAMES W. BOARDMAN.

Witnesses:
ANNA V. BAKER,
MARY E. BAKER.